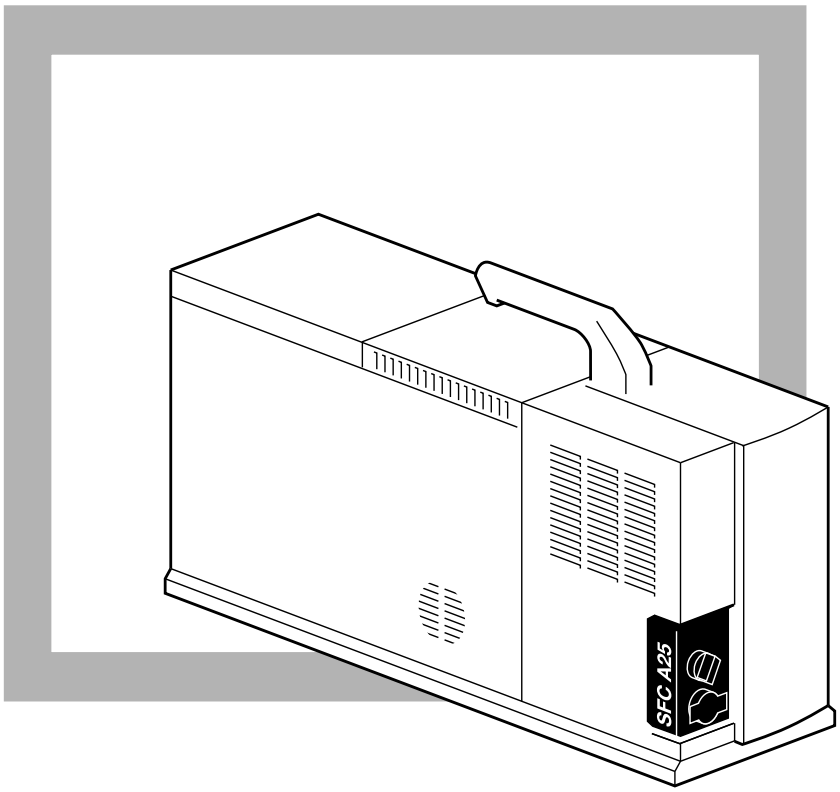
SMART FUEL CELL

POWERS YOUR INDEPENDENCE



SFC A25

Fuel cell system

Operating Manual

1.1 Safety

Read the entire operating manual before starting up the system, and store it with the SFC System. You will then be able to refer to it again if there are any questions later on about system operation. Please comply with all instructions contained in the manual.

Do not use excessive force to open the system and fuel cartridges. Any changes made to the equipment compromise safety and void the operating license.

Do not operate or store the system or fuel cartridges at a temperature higher than 45 °C. Do not expose to heat or direct sunlight.

Keep sources of heat and ignition at a safe distance.

Do not smoke while handling the system or fuel cartridges.

Be sure to keep children away from the system and fuel cartridges.

There is a risk of fire if any methanol has spilled (e.g., after an accident or if fuel cartridges have been damaged). Keep ignition sources at a safe distance and thoroughly ventilate the area. Spilled methanol will evaporate without leaving any residue.

Methanol is poisonous when inhaled, swallowed or when it comes into contact with skin. There is a real risk of serious injury due to inhalation, contact with skin or swallowing. In case of accident or nausea, seek medical assistance immediately and present the fuel cartridge label or the operating manual (there is a methanol safety bulletin in the appendix at the back of this manual).

Below + 1 °C, the system must be turned on (ON or CHARGE), and a full fuel cartridge must be connected. Store the system above +1 °C if you do not plan to operate continuously during winter. This avoids damage caused by freezing (uninstall the fuel cell from the boat/vehicle if necessary).

In addition to complying with all safety notes, be sure to comply with all instructions printed in bold font to minimize risk of injury to yourself and others.

1.2 Regulation compliant use

The SFC A25 is a universal fuel cell power supply system. With the selector switch is in the ON position, connected loads can be operated directly from the supply. In the CHARGE position, a battery can be connected and automatically charged.

Note that the SFC A25 is designed for use as a long-term power supply. Avoid repeated short-term operation of the system.
The SFC can be used in stationary applications as well as in boats and vehicles, provided it is applied in accordance with the specifications.

The SFC is not designed for use as an emergency power supply for vital life-support equipment.

1.3 Declaration of Conformity

SFC Smart Fuel Cell AG, Eugen-Sänger-Ring 4, 85649 Brunnthal-Nord, hereby declares that the fuel cell system SFC A25 conforms to EG Guidelines 89/336/EWG as they relate to electromagnetic compatibility. The following harmonized standards were applied: DIN EN 61000-6-1,
DIN EN 61000-6-3.

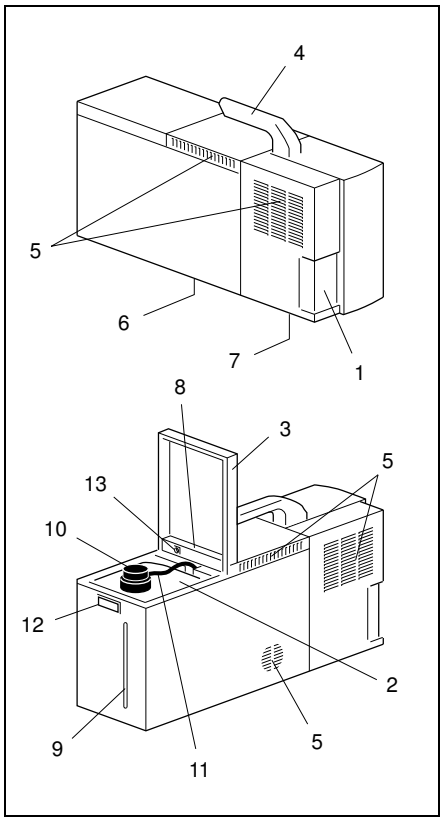
2. Table of Contents

3.1 Package contents

The following items are supplied with the SFC A25 package:

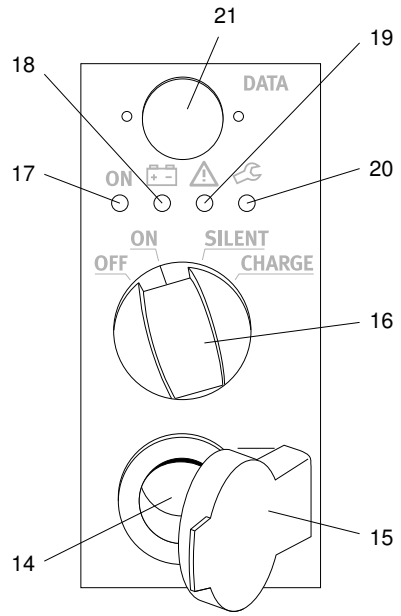
- SFC A25
- German operating manual
- Transportation cartridge
- Charging cable for internal battery
- Spare seal for cartridge connection
- Spare 250V 10A fuse, FF (ultra-rapid), 20x5 mm
- Spare 250V 10A fuse, F (fast-acting), 20x5 mm

3.2 Components



1 Operating panel
2 Fuel cartridge or transportation cartridge
3 Cartridge cover
4 Carrying handle
5 Ventilation opening
6 Internal battery fuse
7 12 V output fuse
8 Spare fuses and sealing ring for cartridge connection
9 Cartridge fill level indicator
10 Cartridge connection
11 Supply line
12 Cartridge cover release button
13 Charging socket for internal battery

3.3 Operating panel



14 Vehicle 12 V power system socket type DIN ISO 4165
15 Protection flap
16 Operating mode selector switch

OFF	off
ON	normal operation
SILENT	silent operation
CHARGE	charge an external battery

17 ON pilot light
18 Internal battery LED
19 Output voltage LED
20 Overload protection warning LED
21 Data interface (for service technicians only)

3.4 LED Indicators

The green and yellow LEDs are provided for information and monitoring purposes only.
A fault exists only when red warning indicators are lit or are flashing (see Chapter 7.2 Fault Indicators).

○ off ◉ flashing ● steady	**Operating mode: ON**	**Operating mode: SILENT**	**Operating mode: CHARGE**
			External battery being charged
● ○ ○ ○			External battery has been charged; SFC operating in standby mode
● ◉ ○ ○	Internal battery being discharged		
● ● ○ ○	Internal battery being charged		
◉ ◉ ○ ○	Freeze protection is active; ready to supply power		Freeze protection active; ready to supply power
● ● ◉ ○	Internal battery is being charged; output power temporarily unavailable		Internal battery being charged; output power temporarily unavailable
○ ◉ ○ ○		Silent operation; internal battery is being discharged	
○ ○ ◉ ○	Fault	Overload or internal battery discharged	Fault
○ ○ ● ○	Fuel cartridge depleted		Fuel cartridge depleted
○ ○ ◉ ●	Overload / short-circuit	Overload / short-circuit	Overload / short-circuit

3.5 Technical specifications

	Performance data
Output power rating	25 W
Voltage	11 … 14 V, compatible with 12 V lead acid batteries
Rated consumption	1.5 liters of methanol per kWh of power produced during continuous operation
	Features
Operating modes	ON Power supply CHARGE regulated charging of an external 12 V lead acid battery (car battery) SILENT silent operation using the integrated buffer battery
Peak rating	80 W short-time rating using integrated buffer battery
Electrical interfaces	Standard 12 V car socket DIN ISO 4165 to charge the internal battery
Electrical protection	Electronic trip on overload (8.5 A, resettable) Fuses: Short-circuit protection 250 V 10 A, FF (ultra-rapid), 20x5 mm Input fuse for internal battery charging circuit 250V 10A F (fast-acting) 20x5 mm
Automatic freeze protection	Below + 10 °C ambient in the ON and CHARGE operating modes
	General data
Noise emission	about 40 dB(A) at a distance of 1 m during fuel cell operation
Maximum dimensions	484 mm x 258 mm x 163 mm (WxHxD)
Weight	9.7 kg (incl. fuel cartridge)

3. Construction

	Ambient conditions
Operating temperature	–20 °C … +40 °C
Storage temperature	+1 °C … +45 °C
Start-up temperature	+1 °C ... +40 °C (system will not start below +1 °C)
Humidity	20 % … 90 %

	Fuel Cartridge M2500
Container	2.5 liter plastic canister with safety lock certified "safety tested" by German TUEV certification authority.
Weight	2.2 kg
Part number	000.082

4.1 Installation location

When used in vehicles and boats, the SFC must be securely tied or bolted down. We recommend using holding plate accessory (part number 000.529) for this purpose.

The SFC shall not be installed in hazardous locations (explosion risk).

The SFC is not waterproof. Do not install where water can enter the equipment.

An integrated automatic freeze protection system protects the system against freezing. It starts to operate at a few degrees above zero. The system must be turned on (selector switch set to ON or CHARGE) and a supply of methanol must be available.

Store the SFC in a warm location if you are not able to change the fuel cartridge on a regular basis. Refer to Chapter 0 Storage.

Ensure that the SFC can be easily removed during winter when planning its installation.

The SFC should be installed in an upright position if possible. Avoid installing more than 20° off level.

The SFC consumes about the same amount of oxygen as a human (about 30 l/h or 43 g/h O_2) when it operates. It also emits small amounts of humid air and carbon dioxide, similar to what humans exhale (about 20 l/h or 39 g/h CO_2).

The SFC shall therefore be installed in a well ventilated location.

The better the ventilation, the lower is the risk of condensation forming on the SFC and the immediate surroundings.

4. Start-up

Ensure that the ventilation openings are not covered up. Maintain a minimum clearance of 10 cm between the ventilation openings and adjacent walls when installing the SFC.

The maximum ambient temperature in the space where the equipment is installed shall not exceed 40 °C (see Chapter 0).

An optional vent hose connector (part number 000.353) and ventilation air hose (part number 000.353) may be purchased and installed to prevent heat buildup in the installation space.

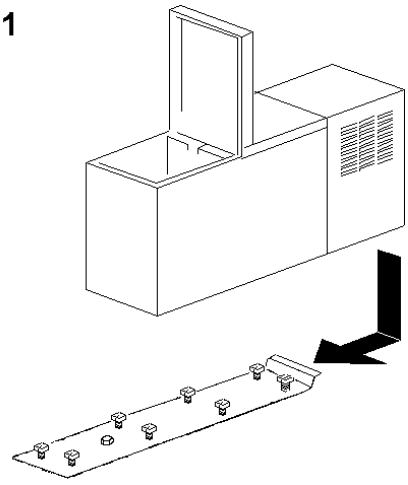
Ensure that the operating panel and the fuel cell cartridge are easily accessible.

Do not operate the SFC in extremely dusty environments; otherwise, the air filter will need frequent replacement.

4.2 Mounting

When the SFC is used in a vehicle or on a boat, it must be mounted so that it will not break loose in the event of an accident.
We recommend using the optional holding plate (part number 000.529) for safe transport.

1

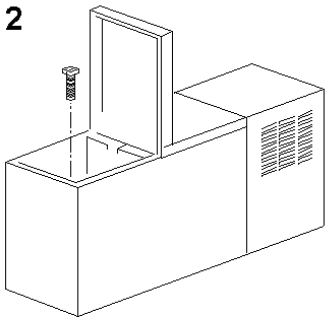


Use the holding plate as a template to mark the hole locations for the mounting screws.

Drill pilot holes for the screws if required. Use suitable screws to firmly attach the holding plate to a fixed base.

Mounting screws for the holding plate are not supplied, since the mounting location and type of base vary greatly. Please obtain advice from a professional installer.

2



Place the SFC in the center of the holding plate and push until it snaps into place. Fasten the SFC to the holding plate through the bottom of the fuel cartridge compartment using the screw provided.

4.3 Electrical connections

Do not wear any metal objects or conductive jewelry when working on the electrics. Use only insulated tools when working on live equipment.

Any wiring connected to the system must be approved for the appropriate voltage and insulation levels and any contact points must be safe to touch. Any electrically conductive components that are part of the connected loads must be shielded so that they cannot be directly touched. Installation of bare wires or exposed contacts is not permitted.

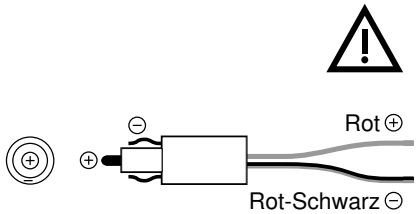
Use only original SFC accessories or a socket as specified by DIN ISO 4165. For further details regarding accessories, please refer to Chapter 0

The SFC can be connected for use as a power source for a mobile 12 V power supply system, a stationary 12 V supply system or a single load (to connect a 12 V lead acid battery, please refer to Chapter 0).

The maximum load rating that can be supplied by the SFC is 25 W at 12 V DC. The SFC has a peak short-time rating of 80 W thanks to an integrated 4 Ah buffer battery.

Use only the optional 12 V mobile power supply system cable to connect equipment. Additional cables may be ordered (part number 000.292) as required (e.g., to connect different loads to the SFC).

Please use the optional 12 V mobile power supply system adapter cable when connecting directly to a 12 V vehicle power supply system. For detailed information regarding accessories, please refer to Chapter 0.



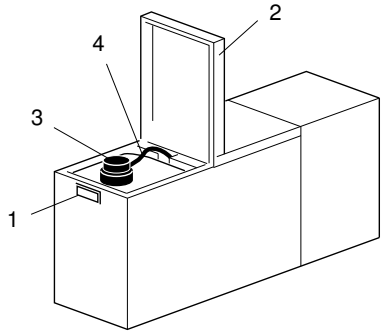
To avoid short circuits, plug the cable into the SFC socket before connecting it to a 12 V mobile supply or to a load.

Check that the polarity is correct. The SFC connector system has the positive pole on the inside and the negative pole on the outer circumference of the plug or socket.

Note:
The 12 V mobile power supply system socket on the SFC is protected by a 250 V, 10 A, FF (ultra-rapid) fuse and a resettable electronic breaker rated at 8.5 A.
The electronic breaker can be reset by turning the SFC off and back on again.

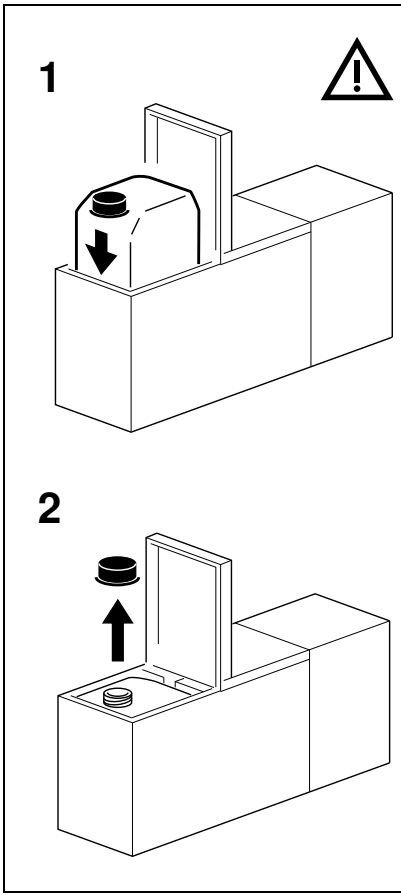
4.4 Removing the transportation cartridge

Use only original SFC fuel cartridges (part number 000.082) to avoid compromising safety.



Prior to using the SFC for the first time, the transportation cartridge must be replaced by a full fuel cartridge.

- Press the cover release button (1) and open the cartridge cover (2).
- Loosen the transportation cartridge connector (3) and remove the cartridge from the SFC.
- First insert the new unopened fuel cartridge, then open the cartridge.



Do not remove the threaded cap from the fuel cartridge until the cartridge has been installed. This will prevent spillage of even small amounts of methanol from the breather valve.

- Firmly tighten the threaded cartridge connector. The upper part of the cartridge connector includes the supply line (4) and must remain movable.

  Close and press on the cartridge cover (2) until you hear it latch.

- The SFC shall only be transported using a transportation cartridge. Do not transport the SFC when fuel cartridges are installed. Safely store the transportation cartridge for reuse.

5.1 Normal operation (ON)

Ensure that the SFC is properly connected to 12 V mobile supply system or a single load (refer to chapter 0).

Once the SFC has been turned on, power will be supplied to all connected loads. Ensure that the loads will not pose any risks when energized.

Do not operate the SFC above 40 °C or below -20 °C.
When the temperature falls below + 1 °C, the system must remain on so that the automatic freeze protection system can operate.

Turn the selector switch to the ON position.

The SFC operates and automatically supplies the necessary power.
If the load draws less than 1 A, power will be supplied by the internal battery. The fuel cell will not operate until the battery has reached its minimum voltage level.

5.2 Silent operation (SILENT)

Turn the selector switch to the SILENT position.

If the internal battery is charged, any connected loads will be supplied using the internal battery.

After the battery discharges to its minimum level, power will be interrupted and the yellow

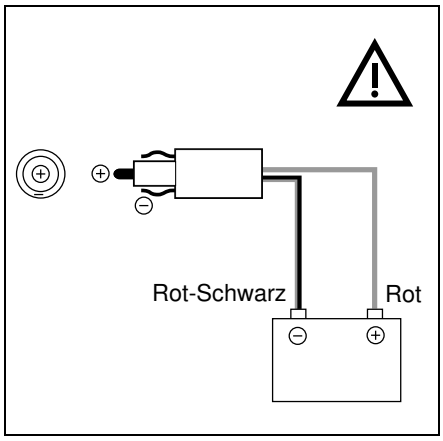
indicator will flash. Turn the selector switch to the ON position to recharge the battery using the fuel cell.

Do not operate the SFC in SILENT mode when the temperature is higher than 40 °C or lower than +1 °C. When the temperature falls below + 1 °C, the system must remain on (ON or CHARGE operating mode) so that the automatic freeze protection system can operate.

5.3 Charging a 12 V car battery (CHARGE)

Only standard 12 V car batteries (lead acid batteries) shall be connected.

Do not operate the SFC above 40 °C or below -20 °C. When the temperature falls below + 1 °C, the system must remain on so that the automatic freeze protection system can operate.



To avoid short circuits, plug the cable into the SFC socket before connecting it to the battery.

Check that the polarity is correct. The SFC connector system has the positive pole on the inside and the negative pole on the outer circumference of the plug or socket.

Turn the selector switch to the CHARGE position.

The SFC will fully charge the battery. The green LED will flash. The SFC then automatically shuts down the power supply, the green LED state changes to steady on and the SFC enters standby mode.

Switching thresholds:

On threshold:	12.5 V
Off threshold:	14.0 V

The above values may vary slightly depending on the length and size of the wiring in the mobile 12 V power supply system.

Use only original SFC wiring accessories or an adaptor as specified by DIN ISO 4165. For further details regarding accessories, please refer to Chapter 0

5.4 Shutdown (OFF)

To avoid damage due to freezing, the SFC must have a full fuel cartridge and be switched to either ON or CHARGE when the temperature falls below 1 °C.

Note that the SFC will not start below +1 °C. Therefore, when colder temperatures are expected, it is important to switch the system to ON or CHARGE before the temperature falls below 1 °C.

If you cannot regularly replace the fuel cartridges before they run out, uninstall the SFC and store it at room temperature. For further information please refer to Chapter 0.

The SFC is designed as a long-term power supply.
The fuel cell uses its internal battery to supply the energy required for starting. Avoid repeatedly operating the fuel cell for less than 1 hour.

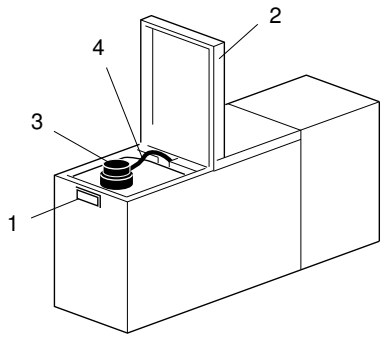
Do not turn off the SFC until the yellow LED state has changed from steady to flashing.

Turn the selector switch to the OFF position to turn off the system.

5.5 Changing the fuel cartridge

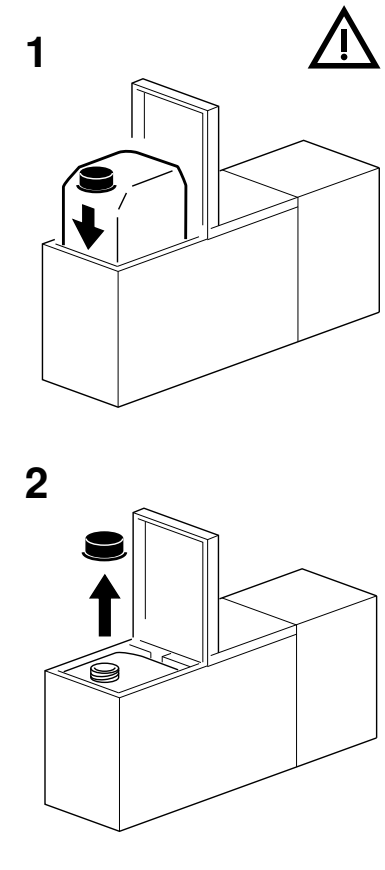
Use only original SFC fuel cartridges (part number 000.082) to avoid compromising safety.

Do not smoke while replacing fuel cartridges!



Note: A red warning indicator lights when the cartridge is empty. The cartridge may be replaced while the system is operating.

- Press the cartridge release button (1) and open the cartridge cover (2).
- Loosen the depleted cartridge connector (3) and remove the cartridge from the system.
- Insert the new unopened cartridge before opening it.



Do not remove the threaded cap until the new cartridge has been installed. **This will prevent spillage of even small amounts of methanol from the breather valve.**

- Check the cartridge connector seal (3) and replace it if necessary (see Chapter 0). Firmly tighten the threaded cartridge connector. The upper part of the cartridge connector includes the supply line (4) and must remain movable.

  Close and press on the cartridge cover (2) until you hear it latch.

- Tightly close the depleted fuel cartridge. Do not discard the depleted fuel cartridges along with household waste. They shall be returned to SFC or an SFC distributor.

Note: If the system has not been operated for an extended period of time, a warning indicator may light when the SFC is turned on, even when the fuel cartridge is full. In such a case, simply cycle the SFC on and off several times.

6.1 Maintenance

Do not open the fuel cell! Unauthorized opening can compromise safe operation and voids all warranties. The SFC does not contain any parts that can be repaired or maintained by the owner.

Under normal operating conditions the SFC is maintenance-free. Please contact Smart Fuel Cell if you wish to operate the SFC under extreme environmental conditions. The address is on the back of the envelope.

6.2 Cleaning

Turn the SFC off before cleaning and disconnect it from the 12 V mobile power supply system or any connected batteries.

The SFC is not waterproof. Ensure that no moisture enters the SFC.

Use only mild cleaning solutions and a damp, soft cloth to clean the SFC.

The safety instructions on the fuel cartridge cover shall not be removed or covered up.

6.3 Storage

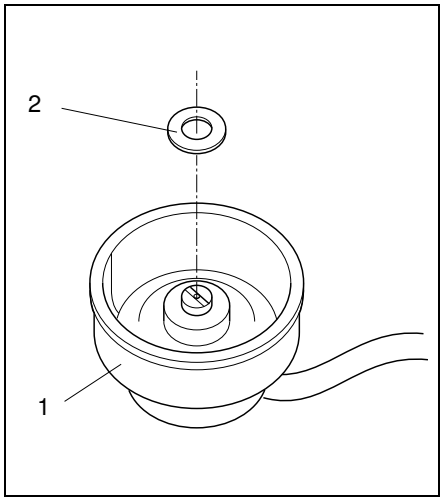
The SFC shall be stored at room temperature (10 °C...25 °C). If the system will not be used for an extended period of time, the SFC shall be operated monthly for at least one hour.

6.4 Replacing the cartridge connector seal

Use only original SFC seals
(part number 000.096)

Do not smoke while working on the SFC, and keep away from ignition sources!

Avoid coming into contact with methanol. Use protective gloves if required.



1 Cartridge connection
2 Seal

- Press the cartridge release button and open the cartridge cover.
- Loosen the fuel cartridge connector (1).
- Take out the old seal (2). Clean the surface on which the seal rests if it is dirty. The cartridge connector must be free of any dirt particles or fibers.
- Install a new, original SFC seal (2).
- Firmly tighten the threaded fuel cartridge connector. The upper part of the cartridge connector includes the supply line and must remain movable.
- Close and press on the cartridge cover until you hear it latch.
- Do not forget to order a replacement seal right away.

7.1 Safety

Do not open the fuel cell! The SFC does not contain any parts that can be repaired by the owner.

Contact Smart Fuel Cell (address on the back of the envelope) if you are not able to solve a problem using the instructions in the operating manual.

7.2 Fault indicators

Description	Possible cause / solution
No response when the system is turned on: no indicators are lit	Internal battery is completely discharged. → Charge the internal battery using the adapter cable (see Chapter 0). If it occurs frequently: → Contact customer service.
	
LED indicators are normal but system does not deliver any power.	Short-circuit protection has tripped → Turn off the system. Find and remove the cause of the short-circuit or overload. Replace the fuse on the underside of the enclosure and restart the system (see Chapter 0). If it occurs frequently: → Check external connections (plugs, wiring, etc.).

7. Problem Solving

Flashing warning indicator  	The battery was too deeply discharged during SILENT mode operation. → Cycle the system on and off and allow it to operate normally for about one hour. → If the problem persists: Charge the internal battery (see Chapter 0) If it occurs frequently: → Contact customer service.
Warning indicator is on steadily  	Fuel cartridge is depleted or improperly connected. → Replace the fuel cartridge and cycle the system on and off or check that the cartridge is properly connected. The fuel cartridge is full, but the SFC was not operated for an extended period of time. → Cycle the SFC on and off several times. Leaking methanol supply line. → Replace the seal on the fuel cartridge connector (see Chapter 0). If the problem persists, contact customer service.
Warning indicator flashes, green and yellow LEDs are on but no output power available  	After a lengthy or highly demanding period of operation the output voltage may be switched off for a short period of time so that the internal battery can be recharged. → Allow the system to continue operation. After a maximum delay of one hour, the system will automatically resume supplying output power.
Warning indicator flashes, overload indicator lit.  	The electronic overload protection has tripped. Normal mode: external short-circuit or overload CHARGE mode: The external battery has not been connected properly or is defective. → Turn off the system, fix the problem and restart the system. If it occurs frequently: → Contact customer service.

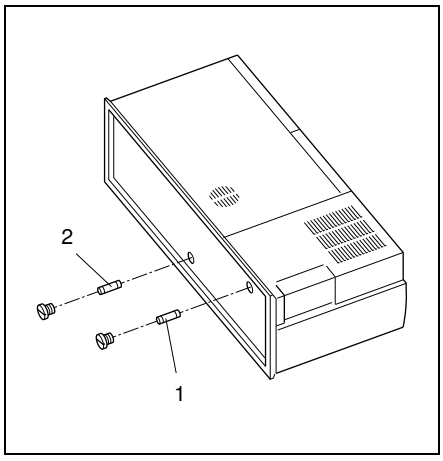
7.3 Fuse replacement

Fuses may only be replaced by specified types that have the named current ratings. Under no circumstances may they be temporarily repaired or bypassed.

Before replacing a fuse: Turn off the SFC. Disconnect the SFC from the 12 V mobile power supply system or any externally connected batteries.

If necessary, remove the SFC from the holding plate. Loosen the screw at the bottom of the fuel cartridge compartment and push the SFC in the direction of the operating panel. You can then lift it up.

Replace the blown fuse.



1. Fuse (vehicle 12 V mobile supply system socket)
   labeled: Output Fuse
   12 V 10 A, FF (ultra-rapid), 20x5mm
   part number 000.424

2. Fuse
   (input for charging the internal battery)
   labeled: Battery Fuse
   250 V 10 A, F (fast-acting), 20x5 mm
   part number 000.454

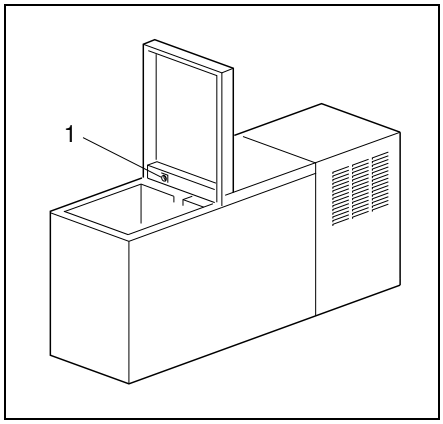
After replacing the fuse, refasten the SFC as described in Chapter 0 if it is being used in a vehicle or a boat.

7.4 Charging the internal battery

If the internal battery has been deeply discharged (e.g., due to an extended period of non-operation), the SFC cannot be started.

Charge the internal battery using the adapter cable supplied (part number 000.358).

Use only the original SFC adapter cable to charge the internal battery in order to comply with safety regulations and preclude voiding any warranties.



To charge the battery, open the fuel cartridge cover and plug the adapter cable into the charging socket (1). Connect the other end to a 12 V DC source. For example, the SFC can be connected to a car cigarette lighter socket. After approximately two hours the SFC may be restarted.

The battery will be completely recharged after approximately 24 hours, depending on the power source.

The charging socket is protected by a 250 V 10 A, F (fast-acting) fuse. See Chapter 0 for instructions on replacing the fuse.

8.1 Accessories

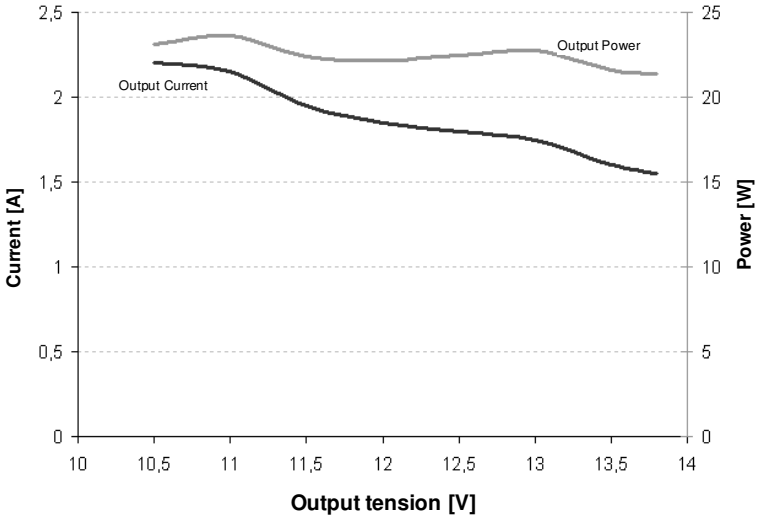
Use only original accessories!
Use of unapproved components compromises safety and voids the warranty.

	Part number
Fuel cartridge M2500	000.082
Adapter cable	000.292
12 V mobile power supply system adapter cable	000.530
Cooling air connector	000.353
Cooling air hose	000.359
Charging cable for internal battery	000.358
Transportation cartridge	000.083
12 V output fuse (12V 10A FF)	000.424
Internal battery charging input fuse (250V 10A F)	000.454
German operating manual	000.195
Replacement seal	000.096
Holding plate	000.529

Customer service for accessories: +49-(0)-89-607-454-99
SFC Smart Fuel Cell AG
Eugen Saenger-Ring 4
D-85649 Brunnthal-Nord, Germany
www.smartfuelcell.com

8.2 Output characteristic

SFC A25 V-I output characteristic in CHARGE operating mode



8.3 Material Safty Data Sheet Methanol

Please comply with the following instructions when handling with the fuel cartridges.

In case of accident or nausea, seek medical assistance immediately and present the fuel cartridge label or the operating manual.

Gemäß Richtlinie 91/155/EWG der Kommission
der Europäischen Gemeinschaften

Issue date : September 2002

1. Identification of the Substances / preparation and the company

1.1 Identification of the substance or preparation:

Synonyms : Methyl alcohol, methyl hydrate, wood spirit, methyl hydroxide
Product use : Solvent, fuel, feedstock

CAS no. :	000067-56-1		
EC index no. :	603-001-00-X	**NFPA code :**	1-3-0
EINECS no. :	200-659-6	**Molecular weight :**	32.04
RTECS no. :	PC1400000	**Formula :**	CH3OH

Company/undertaking identification:
SFC Smart Fuel Cell AG
Eugen-Sänger-Ring 4
D- 85649 Brunnthal-Nord
Tel.: +49 (0) 89 607 454 99
Fax.: +49 (0) 89 607 454 69

Telephone number for emergency:
(+32) 14-58 45 45
Information centre of dangerous goods (B.I.G.)
Technische Schoolstraat 43A, B-2440 Geel, Belgium

2. Composition / information on ingredients

Hazardous ingredients	CAS no.	Conc in %	Hazard class.	Risks (R-phrases)
METHANOL	000067-56-1	99.85	F;T	11-23/24/25-39/23/24/25

3. Hazards identification

- Toxic by inhalation, in contact with skin and if swallowed
- Toxic: danger of very serious irreversible effects through inhalation, in
- contact with skin and if swallowed
- Highly flammable
- May build up electrostatic charges: risk of ignition
- Gas/vapour flammable with air within explosion limits

4. First Aid measures

4.1 Eye contact:

- Rinse immediately with plenty of water for a minimum of 15 minutes, ensuring
- all surfaces and crevices are flushed by lifting lower and upper lids
- Consult a doctor/medical service

4.2 Skin contact:

- Remove clothing before washing
- Wash immediately with lots of water/soap for 15 minutes
- Consult a doctor/medical service if irritation occurs

4.3 After inhalation:

- Remove the victim into fresh air
- Restore or assist breathing if necessary
- Consult a doctor/medical service

4.4 After ingestion:

- Swallowing methanol is life threatening
- Onset of symptoms may be delayed for 18 to 24 hours after ingestion
- If conscious and medical aid is not immediately available, do not induce
- vomiting
- Transport to medical attention

5. Fire-fighting measures

5.1 Suitable extinguishing media:

- Small fires: Powder, carbon dioxide, halon, water spray, Standard foam
- Large fires: Water spray, AFFF(R)(Aqueous Film Forming Foam (alcohol
- resistant)) type with either a 3% or 6% foam proportioning system

5.2 Unsuitable extinguishing media:

- N.D.

5.3 Hazardous Decomposition Products:

- Toxic gases and vapours; carbon monoxide, carbon dioxide and formaldehyde

5.4 Instructions:

- Methanol burns with a clean clear flame, which is almost invisible in daylight
- Keep upwind, mark the danger area
- Concentrations of greater than 25% methanol in water can be ignited
- Cool tanks/drums with water spray and remove them into safety
- Take account of toxic firefighting water
- Use firefighting water with moderation, contain it if possible

5.5 Special protective equipment for firefighters:

- Fire fighters must wear full face, positive pressure, self-contained breathing apparatus or airline and appropriate protective clothing
- Protective fire fighting structural clothing is not effective protection from methanol. Do not walk through spilled product as it may be on fire and not visible

6. Accidental release measures

6.1 Personal protection:

- see 8.3

6.2 Environmental precautions:

- Prevent soil and water pollution
- Substance must not be discharged into the sewer
- Plug the leak, cut off the supply
- Dam up the liquid spill
- Try to reduce evaporation
- Recover methanol or dilute with water to reduce fire hazard

6.3 Clean-up:

- Eliminate all ignition sources
- Fluorocarbon alcohol resistant foams may be applied to spill to diminish vapour and fire hazard
- Maximize methanol recovery for recycling or reuse
- Collect liquid with explosion proof pumps
- For small spills: take up into non-combustible sorbent

7. Handling and storage

7.1 Handling:

- Reduce/avoid exposure and/or contact
- Keep container tightly closed
- No smoking or open flame
- Use spark-/explosionproof appliances and lighting system
- Take precautions against electrostatic charges
- Handle uncleaned empty containers as full ones

7.2 Storage:

- Keep away from heat and ignition sources, oxidizers, acids, bases
- Store in a dry and well-ventilated area
- Store in totally enclose equipment
- Tanks must be grounded and vented and should have vapour emission controls
- Provide for a tub to collect spills
  Issue date : **May 2001 3** / **7**

7.3 Materials for packaging:

- Anhydrous methanol is non-corrosive to most metals at ambient temperatures except lead and magnesium
- Coatings of copper (or copper alloys), zinc (including galvanized steel) or aluminium are unsuitable for storage as they are attacked slowly
- Mild steel is the recommended construction material for tanks

8. Exposure controls/Personal protection

8.1 Recommended engineering controls:

In confined areas, local and general ventilation should be provided to maintain airborne concentrations below permissible exposure limits
Ventilation systems must be designed according to approved engineering standards

Sampling methods:
NIOSH 2000

8.2 Exposure limits:

TLV-TWA :		mg/m3	200	ppm
TLV-STEL :		mg/m3	250	ppm
TLV-Ceiling :		mg/m3		ppm
OES-LTEL :	(266)	mg/m3	(200)	ppm
OES-STEL :	(333)	mg/m3	(250)	ppm
MAK :	270	mg/m3	200	ppm
TRK :		mg/m3		ppm
MAC-TGG 8 h :	260	mg/m3		
MAC-TGG 15 min. :		mg/m3		
MAC-Ceiling :		mg/m3		
VME-8 h :	260	mg/m3	200	ppm
VLE-15 min. :	1300	mg/m3	1000	ppm
GWBB-8 h :	266	mg/m3	200	ppm
GWK-15 min. :	333	mg/m3	250	ppm
Momentary value :		mg/m3		ppm
EC :	260	mg/m3	200	ppm
EC-STEL :		mg/m3		ppm
Odour threshold :			2000	ppm

(irritation at 1000 ppm; poor olfactory warning properties)

Sampling methods:
NIOSH 2000 / OSHA 91

8.3 Personal protection:

eye protection:
- Face shield and chemical splash goggles

hand protection:
- Gloves

skin protection:
- Protective clothing

materials for protective clothing:

- Butyl rubber
- Nitrile rubber

respiratory protection:

- Air respirator when airborne concentrations exceed exposure limits

9. Physical and chemical properties

9.1	**Appearance (at 20°C) :**	Clear liquid	
9.2	**Odour :**	Slight alcohol odour	
9.3	**Colour :**	Colourless	
9.4	**pH value :**	N.D.	
9.5	**Boiling point/boiling range :**	64.5	**°C**
9.6	**Melting point/melting range :**	-97.8	**°C**
9.7	**Flashpoint :**	11	**°C (TCC)**
9.8	**Auto-ignition point :**	385	**°C**
9.9	**Explosion limits :**	6/36	**vol%**
9.10	**Vapour pressure (at 20°C) :**	1278	**hPa**
9.11	**Relative density (at 20°C) :**	0.792	
9.12	**Water solubility :**	Completely	
9.13	**Soluble in :**	Ethanol, ether, acetone, chloroform	
9.14	**Relative vapour density :**	1.1	
9.15	**Saturation concentration :**	166	**g/m3**
9.16	**Viscosity :**	0.0006	**Pa.s**

10 Stability and reactivity

10.1 Stability:

- Stable under normal conditions

10.2 Reactivity/Hazardous decomposition products:

- Reaction with oxidizers, strong acids, strong bases
- May be corrosive to lead and aluminium
- Hazardous decomposition products: formaldehyde, carbon dioxide and carbon monoxide

11 Toxicological information

11.1 Acute toxicity:

LD50 oral rat :	5628	**mg/kg**
LD50 dermal rat :	N.D.	**mg/kg**
LD50 dermal rabbit :	15800	**mg/kg**
LC50 inhalation rat :	85	**mg/l/4 h**

The odour threshold of methanol is several times higher than the TLV-TWA

11.2 Chronic toxicity:

EC carc. cat.:	not listed
EC muta. cat.:	not listed
EC repr. cat.:	not listed
Carcinogenicity (TLV):	not listed
IARC classification:	not listed

11.3 Routes of exposure: swallowed, inhalation, eyes and skin

11.4 Acute effects/symptoms:

- Swallowing even small amounts of methanol may cause blindness or death Effects of sub lethal doses may be nausea, headache, abdominal pain, vomiting and visual disturbances ranging from blurred vision to light sensitivity
- Inhalation of high concentrations: irritation of the mucous membranes, headache, sleepiness, nausea, confusion, loss of consciousness, digestive and visual disturbances and death
- High vapour concentration or contact with liquid: irritation of the eyes, tearing and burning
- May be absorbed through the skin in toxic or lethal amounts

11.5 Chronic effects:

- Repeated exposure by inhalation or absorption: systemic poisoning, brain disorders, impaired vision and blindness
- Inhalation may worsen conditions such as emphysema or bronchitis
- Repeated skin contact may cause dermal irritation, dryness and cracking

Reproductive effects:

- Reported to cause birth defects in rats exposed to 20000 ppm

12 Ecological information

12.1 Ecotoxicity:

- LC50 (96 h) : 10800 mg/l (SALMO GAIRDNERI/ONCORHYNCHUS MYKISS)
- EC50 (48 h) : 24500 mg/l (DAPHNIA MAGNA)
- EC50 (72 h) : 8000 mg/l (ALGAE)

Methanol can be harmful for as well salt water organisms as freshwater organisms

12.2 Mobility:

- Volatile organic compounds (VOC): 100%
- Soluble in water

For other physicochemical properties see section 9

12.3 Persistence and degradability:

▪ biodegradation	BOD5 :	0.6 - 1.1	g O2/g substance
	COD :	1.42	g O2/g substance

- water : Readily biodegradable in water(test: 99% OECD 301D. BOD 80% ThOD)
- soil : N.D.
- Methanol will be broken down to carbon dioxide and water

12.4 Bioaccumulative potential:

- log Pow : -0.82/-0.66
- BCF : < 10 (LEUCISCUS IDUS)
- Slightly bioaccumulative

12.5 Other adverse effects:

- WGK : 1 (Classification in compliance with Verwaltungsvorschriftwassergefährdender Stoffe (VwVwS) of 17 May 1999)
- Effect on the ozone layer : Not dangerous for the ozone layer(Council Regulation (EC) No.3093/94, O.J. L333 of 22/12/94)
- Greenhouse effect : No data available
- Effect on waste water purification : Sludge digestion is inhibited at800 mg/lNitrification of activated sludgeis inhibited at 160 mg/l; 50%

13 Waste disposal considerations

13.1 Provisions relating to waste:

- Waste material code (91/689/EEC, Council Decision 2001/118/EC, O.J. L47 of 16/2/2001): 07 01 04 (other organic solvents, washing liquids and mother liquors)
- Waste material code (Flanders): 001; 015; 034
- Waste code (Germany): 55315
- Hazardous waste (91/689/EEC)

13.2 Disposal methods:

- Incineration is the recommended disposal method
- Biological treatment may be used on dilute aqueous waste methanol
- Methanol wastes are not suitable for underground injection
- Waste materials must be disposed of in accordance with your municipal, state, provincial and federal regulations

13.3 Packaging:

- Waste material code packaging (91/689/EEC, Council Decision 2001/118/EC,O.J. L47 of 16/2/2001): 15 01 10 (packaging containing residues of or contaminated by dangerous substances)

14 Transport information

336
1230

14.1 Classification of the substance in compliance with UN Recommendations

UN-number :	1230
CLASS :	3
SUB RISKS :	6.1
PACKING :	II
PROPER SHIPPING NAME :	UN 1230, Methanol

14.2 ADR (transport by road)

CLASS :	3
PACKING :	II
DANGER LABEL TANKS :	3+6.1
DANGER LABEL PACKAGES :	3+6.1

14.3 RID (transport by rail)

CLASS :	3
PACKING :	II
DANGER LABEL TANKS :	3+6.1
DANGER LABEL PACKAGES :	3+6.1

14.4 ADNR (transport by inland waterways)

CLASS :	3
PACKING :	II
DANGER LABEL TANKS :	3+6.1
DANGER LABEL PACKAGES :	3+6.1

14.5 IMDG (maritime transport)

CLASS :	3
SUB RISKS :	6.1
PACKING :	II
MFAG :	19
EMS :	-
MARINE POLLUTANT :	-

14.6 ICAO (air transport)

CLASS :	3
SUB RISKS :	6.1
PACKING :	II
PACKING INSTRUCTIONS PASSENGER AIRCRAFT :	
PACKING INSTRUCTIONS CARGO AIRCRAFT :	

14.7 Special precautions in connection with transport

none

14.8 Limited quantities (LQ)

When substances and their packaging meet the conditions established by ADR/RID/ADNR in chapter 3.4, only the following prescriptions shall be complied with:
each package shall display a diamond-shaped figure with the following inscription:

- 'UN 1230'

or, in the case of different goods with different identification numbers within a single package:

- the letters 'LQ'

15 Regulatory information

Enumerated in substance list Annex I of directive 67/548/EEC et sequens


Highly flammable


Toxic

R11 :	Highly flammable
R23/24/25 :	Toxic by inhalation, in contact with skin and if swallowed
R39/23/24/25:	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
S(01/02) :	(Keep locked up and out of reach of children)
S07 :	Keep container tightly closed
S16 :	Keep away from sources of ignition - No smoking
S36/37 :	Wear suitable protective clothing and gloves
S45 :	In case of accident or if you feel unwell, seek medical advice (show the label where possible)

16 Other Information

The information provided on this MSDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

N.A. = NOT APPLICABLE
N.D. = NOT DETERMINED
* = INTERNAL CLASSIFICATION

Full text of any R-phrases referred to under heading 2:

R11 :	Highly flammable
R23/24/25 :	Toxic by inhalation, in contact with skin and if swallowed
R39/23/24/25 :	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
Exposure limits:	
TLV :	Threshold Limit Value - ACGIH US 2000
OES :	Occupational Exposure Standards - United Kingdom 2001
MEL :	Maximum Exposure Limits - United Kingdom 2001

MAK :	Maximale Arbeitsplatzkonzentrationen - Germany 2001
TRK :	Technische Richtkonzentrationen - Germany 2001
MAC :	Maximale aanvaarde concentratie - the Netherlands 2002
VME :	Valeurs limites de Moyenne d'Exposition - France 1999
VLE :	Valeurs limites d'Exposition à court terme - France 1999
GWBB :	Grenswaarde beroepsmatige blootstelling - Belgium 1998
GWK :	Grenswaarde kortstondige blootstelling - Belgium 1998
EC :	Indicative occupational exposure limit values - directive 2000/39/EC

NOTE TO PHYSICIAN

Acute exposure to methanol, either through ingestion or breathing high airborne concentrations can result in symptoms appearing between 40 minutes and 72 hours after exposure. Symptoms and signs are usually limited to CNS, eyes and gastrointestinal tract. Because of the initial CNS's effects of headache, vertigo, lethargy and confusion, there may be an impression of ethanol intoxication. Blurred vision, decreased acuity and photophobia are common complaints.

Treatment with ipecac or lavage is indicated in any patient presenting the symptoms within two hours of ingestion. A profound metabolic acidosis occurs in severe poisoning and serum bicarbonate levels are a more accurate measure of severity than serum methanol levels. Treatment protocols are available from most major hospitals and early collaboration with appropriate hospitals is recommended.

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SFC Smart Fuel Cell AG
Eugen Saenger-Ring 4
D-85649 Brunnthal-Nord, Germany
Hotline: +49-(0)-89-607-454-99

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